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STATUS AND HABITAT OF ALABAMA GULF COAST BEACH MICE *Peromyscus polionotus ammobates* AND *P. p. trissyllepsis*[1]

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Abstract: The present study documents the distribution of the gulf coast beach mice (*Peromyscus polionotus ammobates* and *P.p. trissyllepsis*) in Alabama and assesses their status. Since 1921, approximately 62% of beach mouse habitat in Alabama has been lost. Populations of *P. p. ammobates* are concentrated on small tracts of habitat from the Fort Morgan peninsula to Romar Beach. *P. p. trissyllepsis* was found only at one site at Florida Point on Perdido Key. Live trapping for 1,566 trapnights yielded 157 beach mice. Area extrapolations were used to determine the density of *P. p. ammobates*. Approximately 875 *P. p. ammobates* were estimated to live on 134.6 ha (6.5 mice/ha). Only one *P. p. trissyllepsis* was trapped from 25.2 ha. The vegetation of the habitat is described. Factors responsible for the disappearance of beach mice in Alabama are discussed.

More concrete information is needed concerning the distribution and biology of beach mice along the Alabama gulf coast. Their habitat is being impacted by development and recreational activities. The hurricane of September 13, 1979, destroyed many sand dunes and the associated sea oats, the principal food of this mammal. Historically, the beach mouse has been recorded along the sand dune system closest to the beach between Mobile Bay and the Alabama-Florida state line. Howell (1909, 1921) first described this rodent as being confined to the "drifting sand dunes" along the Baldwin County coast. He recorded it around the outer beach near Bon Secour, but did not trap this species from Dauphin Island or any location west of Mobile Bay. Anderson (1960) collected 23 specimens from the Gulf Shores-Romar Beach area that were referable to *P. p. albifrons*. Holliman (1963) collected seven specimens of *P. p. albifrons* from the Fort Morgan area. Bowen (1968) re-examined the taxonomic status of this group and assigned the population from Mobile Bay to Alabama Point and on Ono Island to *P. p. ammobates*. He referred the population east of Perdido Inlet (Florida Point) to the Alabama-Florida state line to *P. p. trissyllepsis*. Linzey (1970) collected three specimens of *P. p. ammobates* there at the Gulf Shores State Park south of Alabama highway 182. He did not locate *P. p. trissyllepsis* west of the Alabama-Florida state line. Both *P. p. ammobates* and *P. p. trissyllepsis* were listed as endangered on the state list by Keeler (1972) and later by Boschung (1976) because of the lack of distributional and ecological data. Holliman (1979) included *P. p. ammobates* and *P. p. trissyllepsis* as two of four endangered mammalian species occuring in the Alabama coastal zone and recommended that research be accomplished relative to their habitat preference and population dynamics. Humphrey and Barbour (1981) cited locations for 19 specimens of *P. p. trissyllepsis* that were collected in Alabama. During their pre-storm study, they estimated that 26 *P. p. trissyllepsis* lived in 2.6 km of habitat of Gulf Beach State Park (Florida Point),

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Alabama, and that 52 individuals lived in 10.4 km of habitat at Gulf Islands National Seashore, Florida. It was the opinion of these authors that these 78 individuals comprised the entire subspecies of *P. p. trissyllepsis.* Fujita *et al.* (1980) and Holliman (1981) described the September 13, 1979 storm damage to coastal habitat.

The purpose of this study was to locate the remaining range of these two populations and assess their status in Alabama.

DESCRIPTION OF HABITAT

The study area is represented in figures 1 and 2.

A digital planimeter at the National Space Technology Laboratories in Hancock County, Mississippi was used to quantify the pre-storm beach-dune complex as mapped by Vittor and Stout (1975), Table 1. Post-storm maps and aerial photography were correlated with ground truth surveys to plot the surviving plant cover. The sizes of areas not flooded (Table 2) were measured from USGS storm maps (1980).

The September 13, 1979 storm either reworked or destroyed the Alabama dune system. Sand displacement was generally towards the northwest, with redeposition occurring on the mainland slopes of secondary and tertiary dune lines. In Alabama, washovers from the Gulf completely destroyed the primary sand dune system at Romar Beach, Gulf Shores State Park, Gulf Shores, Pine Beach, Gulf Highland, and Fort Morgan. Only remnants of the secondary and tertiary lines were left with sand moved inland beyond the beach-dune complex. At Perdido Inlet (U.S. Geologic Survey, 1980), the maximum water level during the storm reached 3.9 m and a 2.4 m level was sustained for two hours. In Gulf Shores, the maximum water level was 3.4 m with a 2.7 m level being maintained for two hours. The maximum water level for the Fort Morgan area was 3.0 m and a 2.4 m level was recorded for three hours. The plant communities on all dunes less than 3.5 m were destroyed. Dune ridges that exceeded 3.5 m were left relatively undisturbed. It was only on the unflooded elevations (Table 2) that beach mouse habitat remains.

Fort Morgan

The majority of this tract is located within the Fort Morgan State Park. It extends eastward beyond the park boundary for ca. ¾ km. Here it is limited by an area of beach-front houses. A single or double row of low dunes (less than 2 m high) parallel the Gulf Beach. These dunes are from 50 to 70 m from the high

Table 1. Pre storm areas of beach-dune habitat in Alabama.

Location	Hectares
Ono Island	105.3
Florida Point to Alabama Florida state line	43.0
Alabama Point to Little Lagoon (Part)	1,089.7
Little Lagoon (Part) to Fort Morgan (Part)	796.4
Fort Morgan (Part)	49.0
Total	2,083.4

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Table 2. Areas of unflooded habitat along Alabama Coast, September 13, 1979.

Location	Hectares
Fort Morgan	11.9
Gulf Highlands	40.2
Pine Beach	45.8
Romar Beach	14.9
Florida Point — Ono Island	47.0
Total	159.8

tide line. *Uniola paniculata* and *Panicum amarum* are the most common plants. A vegetated flood basin on the mainland side of these dunes supports *Panicum amarum, Panicum repens, Andropogon maritimus, Distichlis spicata, Serenoa repens.* This area is inundated at times by standing water. A relic line of sand dunes (14 m high) borders the northern limits of this vegetated flood basin. Large blowouts are conspicuous on the sides of most of them. The woody vegetation on these relic dunes is predominantly *Quercus myrtifolia.*

Gulf Highlands

Eastward this habitat is continuous with the Pine Beach tract. Extensive stretches of bare sand separate two lines of isolated secondary dunes (12 m high) that are predominantly vegetated with *Uniola paniculata, Panicum amarum, Serenoa repens* and *Quercus myrtifolia.* A residential area is located within this tract.

Pine Beach

This is the largest, uninterrupted tract of habitat along the Alabama coast. It is composed of a low line of secondary dunes (12 m high) that is vegetated with *Uniola paniculata* and *Panicum amarum.* A line of isolated tertiary dunes, separated by bare sand areas, are covered with communities of *Andropogon maritimus, Serenoa repens, Quercus virginiana* var. *maritima, Quercus myrtifolia, Uniola paniculata, Panicum amarum, Solidago panciflosuclosa, Paronychia* sp. and *Heterotheca subaxillaris.* Several beach houses are located at the west end of this habitat. There is minimal human disturbance. The eastern end of Pine Beach is part of the Bon Secour National Wildlife Refuge.

Romar Beach

Scattered segments of this habitat are seaward of Alabama Highway 182 with small isolated areas north of the road. The secondary dunes (6 m high) are characterized by *Andropogon maritimus, Uniola paniculata, Panicum amarum, Ceratiola ericoides* and *Euphorbia ammanniodes.* On the crests of the higher tertiary dunes are found clumps of *Quercus virginicus* and *Quercus myrtifolia.* The secondary dunes (10 m high) support *Ceratiola ericoides, Conradina canescens, Asclepias humustrata, Heterotheca subaxillaris, Balduina augustifolia, Hydrocotyle bonariensis, Panicum amarum, Solidago pauciflosculosa, Polygonella gracilis, Paronychia* sp., *Quercus virginicus* var. *maritimus* and *Quercus myrtifolia.* This tract is fragmented by beach houses, trailer parks and state park facilities. Human use is heavy.

Florida Point

The beach-dune complex on Florida Point (Perdido Key) south of Alabama

highway 188 was completely sanded by the Gulf surge during the storm. Thin stands of *Uniola paniculata* and *Panicum amarum* have begun to grow on low dunes. North of the road is a vegetated flood basin. In this shallow depression are two spoil ponds. Around these impoundments grow *Typha latifola, Baccharis* sp., and *Spartina patens.* The shore line of Old River supports sparse growths of *Uniola paniculata* and *Panicum amarum.* Numerous beach trails have been worn through the dune lines by fishermen and swimmers. Human use is heavy.

Ono Island

The gulf side of Ono Island is an almost continuous primary sand dune (15 m high) that has been eroded on the east and west ends. Blowouts are evident along its length. The crest of the dune supports fragmented communities of *Quercus virginiana* var. *maritima, Quercus myrtifolia, Pinus clausa, Pinus elliotti, Polygonella gracilis, Solidago pancifloscula, Serenoa repens, Ceretiola ericoides* and *Conradina canescens.* At the seaward base of the dunes are found *Uniola paniculata, Panicum amarum, Spartina patens, Andropogon maritimus, Panicum repens* and *Serenoa repens.* This sand dune has been subdivided for a residential area and is in the process of being developed.

TRAPPING

Methods

Known localities of beach mice were identified from both published and unpublished records and from museum specimens. The entire coastal beach-dune systems were searched for *P. polionotus* habitat. All areas of potential beach mouse habitat were live trapped. Distribution was determined by live trapping. Areas between the known ranges were developed or washed away. Efforts were concentrated where tracks, burrows, scats, or runways were found. Sherman live traps baited with peanut butter, rolled oats, sunflower seeds, or mixed grains were used. Pine Beach was chosen for a population study site. Initial trapping suggested that the population here was continuous and uniform. One sample area was established. (See Figure 1). This sample area consisted of a transect 210 m long. It was located along the first continuous dune line closest to the ocean. Trapping stations were located at 15 m intervals along this line. Two Sherman live traps were placed at each station. Trapping was conducted for three consective nights, April 29, 30 and May 1, 1982. Beach mice were toe-clipped and released. Movements of individuals up and down the traplines were used as the basis for establishing the boundary of the sampling area. A zone

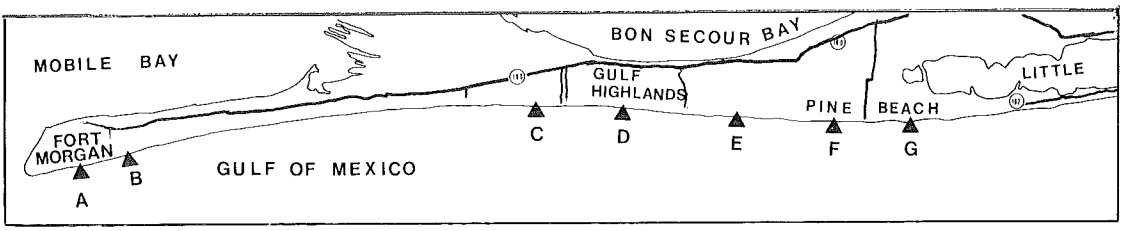

Figure 1. Western portion of study area.

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equal to ½ the average home range around the traps was established and a density value calculated. Direct enumeration was used for estimating the trappable population size. Each trapping station was centered in a 10 x 10 m grid. The number of potential mammalian predators was estimated by counting fresh sets of individual tracks in the grids when the traps were checked each morning. The presence of potential non-mammalian predators was noted. The period of the study extended from January to July, 1982.

RESULTS

Trapping results are given in Table 3. In 1,456 trap nights, 156 *P. p. ammobates* were captured. Other rodents trapped within the range of *P. p. ammobates* were 9 *Peromyscus gossypinus* and 11 *Sigmodon hispidus.* In 110 trap nights, 1 *P. p. trissyllepsis* was captured. No other rodents were trapped within the range of *P. p. trissyllepsis.* Extrapolations from the data and the area of occupied range indicated that 13 *P. p. ammobates* lived on 2.0 ha on the Pine Beach study tract. The total population estimate for this study showed that there were 6.5 beach mice/ha.

All trapping sites were surveyed for predators. The mean number for mammalian track counts in the beach-dune complex was 0.2 *Vulpes vulpes fulva* (red fox), 0.2 *Procyon lotor* (raccoon), 0.01 *Mustela frenata,* (long-tailed weasel), 0.3 *Mephitis mephitis (striped skunk), and 0.5 Felis cattus* (house cat) per trapping site per night (n = 25 trap nights). Red foxes were recorded only from the Fort Morgan area. Weasels and house cats were encountered only on Ono Island. The mean number of avian predators was 1.3 per observer hour for *Falco sparverius* (American Kestrel), and 0.3 per observer hour for *Circus cyanceus* (Northern Harrier) in all study areas on January 29, 1982 (n = 6 observer hours). An unidentified snake drag was seen in the eastern Pine Beach tract.

DISCUSSION

On dunes closest to the ocean, beach mice were associated with *Uniola paniculata* and *Panicum amarum.* In these locations mouse burrows and ghost crab tunnels were evident. On dunes beyond the first berm mice were commonly found in communities of

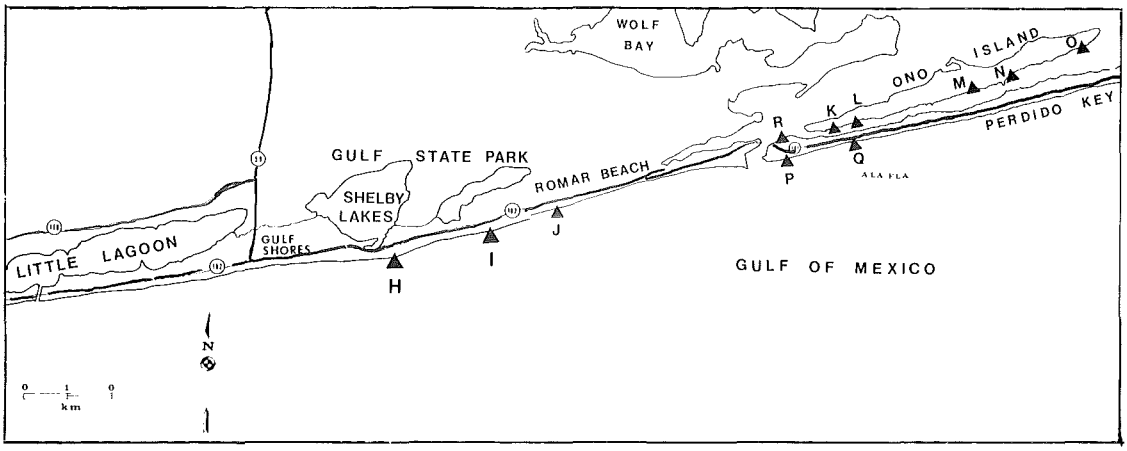

Figure 2. Eastern portion of study area.

Table 3. Results of rodent trapping in the ranges of the two subspecies of *Peromyscus polionotus.* Site letters are as in Figures 1-2. Number of recaptures of mice in Pine Beach study are in parentheses.

Trapping Sites	Date of Trapping	Trapnights	Number of Captures (Individuals) *Peromyscus polionotus*	*Sigmodon hispidus*	*Peromyscus gossypinus*
Areas trapped for *P. p. ammobates*					
A	05-18-82	100	10	0	0
B	03-25-82	99	6	2	0
C	04-24-82	100	1	3	1
D	07-13-82	50	9	0	0
E	04-03-82	96	9	0	0
F	03-10-82	99	6	0	0
	03-14-82	149	23	0	0
	04-29-82	28	17	0	0
	04-30-82	28	21 (10)	1	0
	05-01-82	28	19 (17)	0	0
G	04-17-82	100	12	0	4
H	02-20-82	14	0	0	2
I	05-26-82	100	1	1	2
J	02-18-82	50	4	0	0
	02-20-82	66	14	2	0
	02-22-82	99	4	0	0
K	01-29-82	50	0	2	0
L	02-04-82	50	0	0	0
M	01-30-82	50	0	0	0
N	01-05-82	50	0	0	0
O	01-20-82	50	0	0	0
Areas trapped for *P. p. trissyllepsis*					
P	02-14-82	25	0	0	0
Q	04-14-82	30	1	0	0
	06-18-82	30	0	0	0
R	02-14-82	25	0	0	0

Ceratiola erocoides, Quercus sp., *Pinus clausa* and *Serenoa repens.* In some instances they were trapped on severely eroded secondary and tertiary dunes several hundred m from the primary dune line. These higher dunes probably served as a refuge for the population during the storm.

The total number of beach mice in the occupied range was estimated by area extrapolation from sample data. This is an appropriate method because beach mice were taken more than 50 m from the beachward boundary of dune vegetations. Humphrey and Barbour (1981) used the linear method because of the narrowness of the occupied habitat along the Florida beaches. The farthest inland that they captured beach mice was 50 m from the gulf edge of vegetation. For a different site and subspecies my estimate exceeds that calculated by Blair (1951). His data fluctuated around 2.2 beach mice/ha. The population that I sampled was probably concentrated due to extensive loss of habitat during the storm. Moreover Blair (1951) studied habitats that were not homogeneously productive. My figures probably underestimate the total population size of *P. p. ammobates;* all mice captured on the last night had not been previously marked. Hence the total population of this subspecies is ca. 875 for the estimated 134.6 ha of post-storm habitat. The capture rate for *P. p. ammobates* was 11 percent (n = 1,456 trapnights).

A study by area extrapolation was

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not initiated in the range of *P. p. trissyllepsis* because of the lack of habitat. A careful search of the 25.2 ha of existing dunes was made. A total of 110 trapnights on four different occasions yielded one specimen. This single mouse was captured 30 m seaward of Alabama highway 182 in a sparse stand of *Uniola paniculata.* This area had been under 2.4 m of water for two hours during the storm (U.S. Geologic Survey, 1980). It can only be speculated that this mouse and possibly others found a fortuitous refuge during the storm.

Red fox have been recorded throughout the Alabama Gulf coast since the late 1940's (Holliman, 1963). This is consistent with Humphrey and Barbour (1981) who state that there has been a decrease of red fox sightings since the early 1950's. Bowen (1968) described weasel and house cat predators on Ono Island and suggested that there was an imminent threat of extripation of beach mice by the cat population. Howell (1921) reported the striped skunk to be common, and data from the present study indicate that this mammal still occurs throughout this coastal region. *Urocyon cinereoargenteus* (gray foxes) and *Lynx rufus* (bobcats) are prevalent north of the beach-dune complex but were not noted during this study.

At the time of Howell's work (1921) the beach-dune system was continuous and extended for 55 km from Bon Secour to Ono Island. Approximately 21 km of non-contiguous dunes remain from the Fort Morgan peninsula to the Alabama-Florida state line. This area encompasses 159.8 hectares and represents 8 per cent of the original pre-storm habitat. In this study beach mice were found in localities that ranged from being severely disturbed by off-road vehicles and humans on foot (Perdido Key) to small tracts of habitat fragmented by beachfront development and access roads to the beach (Pine Beach). Most of the remaining areas (Romar Beach - Gulf State Park) are deteriorating because of developmental encroachment and heavy recreational use. Although other sites exist on public lands (Fort Morgan State Park and Bon Secour National Wildlife Refuge), little concerted effort has yet been made in these areas to ensure dune preservation. Beach mice were absent from areas where the habitat was altered by residential and commercial development. My data indicate that *P. p. ammobates* live on disjunct tracts of the beach-dune system along the Alabama coast from the Fort Morgan State Park to the Romar Beach area. This subspecies was not found on Ono Island. *P. p. trissyllepsis* is probably extant on Perdido Key but is on the verge of extinction. Humphrey and Barbour (1981) estimated a total of 78 individuals for this entire subspecies.

Four non-exclusive hypotheses have been proposed by other workers to explain the disappearance of beach mouse populations. (1) Loss of populations is a direct result of habitat loss (Bowen, 1968; Ehrhart, 1978a, 1978b). My data support this possibility and confirm the significance of severe tropical storms on beach mouse habitat in Alabama. The U.S. Geologic Survey (1980) has estimated the maximum hurricane tide to have a recurrence interval of about 25 to 30 years. This means that the Alabama coast line may be reworked on the average of about 40 times in a 1000 year period. Heavy vehicular traffic and foot paths within the beach-dune complex have resulted in the destruction of grass communities to an extent that many dunes will eventually disappear. These factors have contributed to the isolation of *P. polionotus* populations. (2) Beach mice succumb to competition from

house mice (*Mus musculus*) that accompany human settlement (Humphrey and Barbour, 1981). House mice were not collected in beach mouse habitat during this study, but municipal areas were not trapped. My data suggest that house mice and beach mice may be allopatric. If such a process operates, probably it would occur in narrow zones of habitat. This hypothesis should be tested more thoroughly in Alabama. (3) Beach mouse populations are extirpated by predation from house cats (Bowen, 1968; Ehrhart, 1978b). The predator data from Ono Island suggest that house cats may be responsible for the absence of this insular population of beach mice. (4) Overwintering savannah sparrows, (*Passerculus sandwichensis*) may impact beach mouse populations through competition for food (Gentry, 1966). Our few data are not adequate to support or refute this hypothesis. The mean number of savannah sparrows was 0.5 per observer hour for all study areas on January 29, 1982, (n = 6 observer hours).

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